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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Malcolm Reginald Bell et al.

Serial No.: 10/551,511 Group Art Unit: 3653

Filed: October 3, 2006 Examiner: Mark J. Beauchaine

For: COIN ACCEPTOR

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

CERTIFICATE OF MAILING (37 C.F.R.§1.8(A))

Sir:

I hereby certify that the attached:

1. Response to Office Action (11 pages)
2. Certified Priority document – Great Britain Patent Application No. GB0307880.5
3. Return receipt postcard

along with any paper(s) referred to as being attached or enclosed and this Certificate of Mailing are being deposited with the United States Postal Service on date shown below with sufficient postage as first-class mail in an envelope addressed to the: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Respectfully submitted,
ORRICK, HERRINGTON & SUTCLIFFE LLP

By: Girlene Banks
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Dated: October 23, 2008

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PATENT APPLICATION
Attorney Docket No.: 020305-004006
(formerly 17178.006)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Malcolm Reginald Hallas Bell, et al.	
Serial No.:	10/551,511	
Filed:	October 3, 2006	
For:	**COIN ACCEPTOR**	
Examiner:	Mark J. Beauchaine	Group Art Unit: 3653

RESPONSE TO OFFICE ACTION

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicants submit herewith a response to the Office Action dated July 23, 2008. This response is timely filed on October 23, 2008. Applicants respectfully request reconsideration of the instant application, in view of the following amendments and remarks.

Amendments to the claims are included in the claim listing beginning on page 2 of this paper.

Remarks begin on page 5 of this paper.

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1. (previously presented) A coin acceptor comprising:

a coin sensing station,

a coin rundown path extending through the sensing station,

the coin rundown path including a coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the coin sensing station, wherein the path is curved such that the face of the coin is urged by centripetal force against the coin guiding surface as it moves along the path and through the coin sensing station.

2. (cancelled)

3. (previously presented) A coin acceptor according to claim 1 further comprising:

a body including the coin guiding surface, and a cover mounted on the body, wherein the coin rundown path extends between said surface and the cover.

4. (original) A coin acceptor according to claim 3 wherein the cover is fixedly mounted on the body, without a coin jam release mechanism.

5. (previously presented) A coin acceptor according to claim 1 further comprising:

a coin inlet opening and a curved inlet surface for guiding a coin inserted in the coin inlet to a particular region of the coin guiding surface.

6. (previously presented) A coin acceptor according claim 1 wherein the coin guiding surface is configured to relieve a pressure differential between the major face of the coin and the coin guiding surface.

7. (previously presented) A coin acceptor according to claim 1 wherein the coin rundown path extends through sensor coils at the coin sensing station, and one of said sensor coils comprises an elongate winding extending longitudinally along the coin rundown path.

8. (previously presented) A coin acceptor according to claim 7 wherein said one of the coils is wound on an elongate former which is longer than it is wide.

9. (previously presented) A coin acceptor according to claim 8 wherein said one of the coils is longer than the maximum diameter of coins to be accepted thereby.

10. (previously presented) A coin acceptor according to claim 7 including at least one coil of circular cross section at the sensing station.

11. (original) A coin acceptor according to claim 10 wherein the circular coil has a diameter smaller than the minimum diameter of coins to be accepted thereby.

12. (previously presented) A coin acceptor according to claim 7 further comprising:

processing circuitry coupled to the elongate coil to derive therefrom a coin parameter signal as a function of coin diameter.

13. (previously presented) A coin acceptor comprising:

a coin sensing station,

a coin rundown path extending through the coin sensing station,

the coin rundown path including a curved coin guiding surface on which a major face of the coin is urged by centripetal force to lie in sliding engagement during its passage along the coin rundown path through the coin sensing station, and

a side wall opposite to the curved coin guiding surface, said coin rundown path extending between the coin guiding surface and the sidewall, wherein said side wall is fixedly mounted relative to the curved coin guiding surface.

14. (previously presented) A coin acceptor comprising:

a coin sensing station,

a coin rundown path extending through the coin sensing station,

the coin rundown path including a curved coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the coin rundown path through the coin sensing station, and

means to relieve a pressure differential between the major face of the coin and the curved coin guiding surface to inhibit coins sticking to the curved coin guiding surface.

15. (original) A coin acceptor according to claim 14 including pressure relief holes through the coin guiding surface.

REMARKS

The Office Action dated July 23, 2008 has been carefully considered. Claims 1 and 3-15 are currently pending. Reconsideration and allowance of the present application in view of the following Remarks are respectfully requested.

In the Office Action dated July 23, 2008, the Examiner:

- Rejected claims 1, 3-6 and 13 under 35 U.S.C. § 103(a), as being unpatentable over U.S. Patent Application Publication No. US 2003/0150687 to King in view of U.S. Patent No. 5,480,348 to Mazur.
- Rejected claims 7-12 under 35 U.S.C. 103(a) as being unpatentable over King in view of Mazur and further in view of U.S. Patent No. 4,989,714 to Abe.
- Rejected claims 14 and 15 under 35 U.S.C. 103(a) as being unpatentable over King in view of Mazur and further in view of U.S. Patent No. 6,109,417 to Kovens *et al.*

35 U.S.C. § 103(a)

Independent Claim 1

Independent claim 1 was rejected under 35 U.S.C. § 103(a) as being obvious over U.S. Patent Application Publication No. US 2003/0150687 to King in view of U.S. Patent No. 5,480,348 to Mazur. Claim 1 discloses a coin acceptor comprising: a coin sensing station, a coin rundown path extending through the sensing station, the coin rundown path including a coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the coin sensing station, wherein the path is curved such that the face of

the coin is urged by centripetal force against the coin guiding surface as it moves along the path and through the coin sensing station.

The Examiner concedes that King does not disclose a curved rundown path; but asserts that Mazur teaches coin rundown path 410 that has a curved guiding surface on which a major face of a coin slides and is urged by centripetal force as it passes sensing station 411/412, and a side wall opposite said curved guiding surface (see Figure 54) for the purpose of directing coins being processed within said acceptor. Applicants respectfully traverse the rejection and submit that the invention is patentable over King in view of Mazur because Mazur also fails to disclose, teach or suggest a curved rundown path.

In the amendment filed on January 4, 2008, claim 1 was amended to specify that: "the path is curved such that the face of the coin is urged by centripetal force against the coin guiding surface as it moves along the path and through the coin sensing station." The invention addresses the problem of coin wobble that can occur in the prior art as a coin passes through the sensing station. Coin wobble can degrade the sensor output. According to the invention, the face of the coin is held by centripetal force against the curved coin guiding surface as it passes through the coin sensing station and in this way, coin wobble is prevented.

The Examiner considers that the exit chute 410 of Mazur as equivalent to the rundown path claimed. However, Applicants respectfully submit that exit chute 410 does not provide a curved path such that the face of the coin is urged by centripetal force against the coin guiding surface as the coin moves along the path and through the coin sensing station. As shown in

Mazur Figure 54a, coin under test is ejected from a rotary disc into the exit chute 410 in a horizontal manner in a straight line not along a curve. The coin then passes horizontally along the straight portion of exit chute 410 through the second sensor ("coin sensing station"), formed by a light source 411 and a photodetector 412. Thereafter, the coin engages with curved portion of exit chute 410 and at that point is urged by centripetal force so as to turn through 90° downward to a collection point, similarly to one shown in Mazur Fig. 18. The curvature in exit chute 410 only guides the coin after the coin has already passed the coin sensing station, but does not guide the coin through the coin sensing station as claimed in claim 1. Thus, Mazur does not teach a curved rundown path urging the face of a coin by centripetal force against the coin guiding surface as the coin moves through the coin sensing station. Instead, Mazur teaches ejecting coins in free flight horizontally to be sensed by the sensing station 411, 412 and thereafter using the curved surface of the exit chute 410 to re-direct the coins downwardly toward the collection point. Therefore, the coins ejected by Mazur when in free flight almost certainly will wobble, which will degrade the action of the sensor 411, 412, particularly if an inductive sensor were used, as in King. Even if the coins do not wobble, it would be due to size of the opening of the exit chute, rather than the curved path and the centripetal force applied.

Therefore, it is respectfully submitted that Mazur and King combined do not disclose, teach or suggest a coin rundown path including a curved coin guiding surface on which a major face of the coin is urged by centripetal force to lie in sliding engagement during its passage along

the coin rundown path through the coin sensing station. Accordingly, Applicants respectfully request that the rejection of independent claim 1 based King and Mazur be withdrawn.

Moreover, as claims 3-12 all depend from independent claim 1, Applicants respectfully submit that these claims are equally allowable. Withdrawal of these rejections and allowance of claims 3-12 are also respectfully requested.

Independent claim 13

Claim 13 is directed to a coin acceptor comprising: a coin sensing station, a coin rundown path extending through the coin sensing station, the coin rundown path including a curved coin guiding surface on which a major face of the coin is urged by centripetal force to lie in sliding engagement during its passage along the coin rundown path through the coin sensing station, and a side wall opposite to the curved coin guiding surface, said coin rundown path extending between the coin guiding surface and the sidewall, wherein said side wall is fixedly mounted relative to the curved coin guiding surface.

Similar to the argument presented above, the combination of King and Mazur do not render claim 13 obvious and unpatentable. Although Mazur teaches an exit chute 410 that may be curved after the coins have already pass through the coin sensing station, exit chute 410 does not include a curved coin guiding surface on which a major face of the coin is urged by centripetal force to lie in sliding engagement during its passage along the coin rundown path through the coin sensing station. As shown in Fig. 54, the path for the coins in the exit chute 410 appears to be straight and flat, with a slot sized to receive the coins. Nothing in the drawing or

the specification of Mazur teaches or suggests having an exit chute with a curved guiding surface along the coin traveling path through the coin sensing station. Nothing in King and Mazur combined discloses, teaches or suggests that exit chute 410 having a curved guiding surface that guides the coin through the coin sensing station. Reconsideration and withdrawal of rejection of independent claim 13 based on King and Mazur are thereby respectfully requested.

Dependent claims 7-12

The Examiner rejected claims 7-12 under 35 U.S.C. § 103(a) as being unpatentable over King in view of Mazur and Abe (U.S. Patent No. 4,989,714). Applicants respectfully traverse the rejection because King and Mazur do not disclose, teach or suggest a coin rundown path including a coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the coin sensing station, wherein the path is curved such that the face of the coin is urged by centripetal force against the coin guiding surface as it moves along the path and through the coin sensing station. Abe does not overcome the shortcomings of King and Mazur. Therefore, King, Mazur and Abe combined do not render claims 7-12 obvious because they fail to disclose, teach or suggest all the claimed elements of the base claim, claim 1.

Independent claim 14

Independent claim 14 was rejected under 35 U.S.C. § 103(a) as being obvious over U.S. King in view of Mazur and in view of Kovens (U.S. Patent No. 6,109,417). Claim 14 is directed to a coin acceptor comprising: a coin sensing station, a coin rundown path extending through the

coin sensing station, the coin rundown path including a curved coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the coin rundown path through the coin sensing station, and means to relieve a pressure differential between the major face of the coin and the curved coin guiding surface to inhibit coins sticking to the curved coin guiding surface.

First, as presented above, Applicants respectfully submit that Mazur's exit chute 410 does not include a curved coin guiding surface on which a major face of the coin lines in sliding engagement during its passage along the coin rundown path through the coin sensing system.

Second, Applicants respectfully submit that exit chute 410 does not have a curved guiding surface 410 configured to relieve a pressure differential between the major coin face and the guiding surface. There is no teaching, disclosure or suggestion that the exit chute 410 contains holes or other means to relieve the pressure differential that may occur between the coin and the surface. Kovens does not cure this deficiency. Although Kovens discloses apertures 44, these apertures are in the floor 18 of the coin race 12 and the floor 36 of the coin race insert 30. As stated in Kovens specification, "[a]pertures 44 serve to prevent salting by draining liquid that may find its way into the coin entrance 24 before the liquid reaches the electronic components of the coin acceptance assembly." Kovens Col. 4, lines 38-42. This language makes clear that the apertures in Kovens are for discharging liquids and have no purpose in relieving a pressure differential between a curved guiding surface and a major surface of the coin. The only pressure relief is for the discharger of the liquid. Applicants respectfully submit that a person ordinary

skilled in the art would not find holes for draining liquids as teaching or suggesting that holes can be used for relieving a pressure differential in the specific configuration of a curved coin guiding surface used for guiding the major surface of a coin through a sensing station.

CONCLUSION

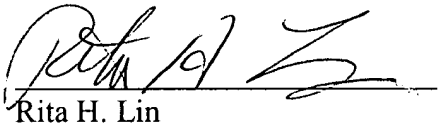
Based on the foregoing amendments and remarks, Applicants respectfully request reconsideration and withdrawal of the rejection of claims and allowance of this application.

We also enclosed herewith the certified copy of Great Britain Patent Application No. GB0307880.5 from which this application claims priority.

The Commission is hereby authorized to charge any additional fees which may be required for this response, or credit any overpayment to Deposit Account No. 15-0665, Order No. 020305-004006.

Respectfully submitted,
ORRICK, HERRINGTON & SUTCLIFFE LLP

Dated: October 23, 2008

By: 
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the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of e Comptroller-General, hereby certify that annexed hereto is a true copy of the documents originally filed in connection with patent application GB0307880.5 filed on 4 April 2003.

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Request for grant of a patent

THE PATENT OFFICE
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LONDON

1/77

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1.	Your reference	MCR/43521GB1
2.	Patent application number	0307880.5 — 0 4 APR 2003
3.	Full name, address and post code of the or each applicant	Money Controls Limited Coin House New Coin Street Royton Oldham OL2 6JZ 8373411002
	Patents ADP number	
	If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom
4.	Title of the invention	Improved Acceptor
5.	Name of your agent	VENNER, SHIPLEY & CO
	"Address for service" in the United Kingdom to which all correspondence should be sent	20 LITTLE BRITAIN LONDON EC1A 7DH
	Patents ADP	1669004

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and the or each application number

Country	Priority application number	Date of filing

7. If this application is divided or otherwise derived from an earlier UK application, give the number and filing date of the earlier application

Number of earlier application	Date of Filing

Patents Form 1/77

8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'YES' if:* *a) any applicant in 3. above is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body)*	YES
9.	Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document	
	Continuation sheets of this form	
	Description	11
	Claim(s)	3
	Abstract	1
	Drawing(s)	9
10.	If you are also filing any of the following state how many against each item.	
	Priority documents	N/A
	Translations of priority documents	N/A
	Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
	Request for preliminary examination and search *(Patents Form 9/77)*	1
	Request for substantive examination *(Patents Form 10/77)*	
	Any other documents	
11.		I/We request the grant of a patent on the basis of this application.
	Signature	Date
	Venner, Shipley LLP	4 April 2003
12.	Name and daytime telephone number of person to contact in the United Kingdom	Matthew Read 020 7600 4212

Improved Acceptor

Description

This invention relates to an improved acceptor for coins, tokens or like items with an attributable monetary value.

Conventional coin acceptors include a coin rundown path down which coins travel through a sensing station where sensors detect characteristics of the coin. Examples are described in our GB-A-2 169 429 and WO99/23615. Typically, inductive sensors are provided at the sensing station which perform inductive coin tests and produce coin parameter signals that are a function of the material and metallic content of the coin under test. Other sensors may be used, such as one or more optical sensors. The coin parameter signals are digitised and compared with stored coin data by means of a micro controller to determine the acceptability and often the denomination of the tested coin. If the coin is found to be acceptable, the micro controller operates an accept gate and the coin is directed to an accept path, but otherwise the accept gate remains closed and the coin is directed to a reject path.

The coin rundown path comprises an inclined rundown surface or flight deck, along which the coins roll edgewise through the coin sensing station, the flight deck being disposed between closely spaced, generally upwardly extending side walls which maintain the coin with its perimeter edge on the flight deck. One or both of the side walls may be inclined to the vertical so to encourage the coin under test to tip over whilst moving down the flight path, so that one of its major surfaces tends to slide along one of the side walls. This is intended to reduce wobbling of the coin on the rundown path. Coin wobble can vary the distance between the inductive sensors and successive coins as they pass through the sensing station, and produce an unwanted variation in the inductive coupling with the sensors from coin to coin as they are tested, which degrades the coin parameter signals.

Coins may become jammed in the coin rundown path. Conventionally, this problem has been addressed by moving the side walls apart to clear the jam. One of the sidewalls is formed as a part of the main body of the acceptor and the other side wall is defined by a surface on a door that is hinged on the main body. In the event of a coin jam, a release mechanism is operated to open the hinged door slightly, thereby moving apart the side walls so that the jammed coin can fall off the flight deck and into the reject path. The provision of a door however, undesirably adds to the manufacturing cost of the coin acceptor. Also, if the sensors are mounted on the door, a flexible wiring harness needs to be provided to accommodate the hinge and connect the sensors to the micro controller on the main body. The harness also adds to the manufacturing cost.

In accordance with invention there is provided a coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, the path including a coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the sensing station, wherein the path is curved such that the said face of the coin is urged by centrifugal force against the coin guiding surface as it moves along the path.

The pressing of the major surface of the coin against the coin guiding surface by centrifugal force reduces the likelihood of coin wobble. Also, the coin path can be made much wider than hitherto, which may obviate the need for a coin jam release mechanism such as the hinged door often used hitherto.

The coin acceptor may have a main body with the coin guiding surface, and a cover mounted on the body, such that the coin path extends between said surface and the cover. The cover can fixedly mounted on the body, without the need for a coin jam release mechanism.

A coin inlet may be provided, with a curved inlet surface for guiding a coin inserted in the inlet to a particular region of the coin guiding surface.

The invention also provides a coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, and sensor coils at the coin sensing station, one of said coils comprising an elongate winding extending longitudinally along the coin rundown path.

The elongate coil may be wound on an elongate former which is longer than it is wide and may be longer than the maximum diameter of coins to be accepted thereby. Processing circuitry may be coupled to the elongate coil to derive therefrom a coin parameter signal as a function of coin diameter.

At least one coil of circular cross section may also be provided at the sensing station, which has a diameter smaller than the minimum diameter of coins to be accepted.

The invention further includes a coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, the path including a curved coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the sensing station, and a side wall opposite to the coin guiding surface, said coin rundown path extending between the coin guiding surface and the sidewall, wherein said side wall is fixedly mounted relative to the curved coin guiding surface.

The invention also provides a coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, the path including a curved coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the sensing station, and means to relieve a pressure differential between the major face of the coin and the coin guiding surface to inhibit coins sticking to the coin guiding surface.

The acceptor may include pressure relief holes through the coin guiding surface.

In order that the invention may be more fully understood an embodiment thereof will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic block diagram of a coin acceptor in accordance with the invention;

Figure 2 is a schematic block diagram of the circuits of the acceptor shown in Figure 1;

Figure 3 is schematic, perspective, exploded view of the acceptor;

Figure 4 is a side view of the interior surface of the right side cover;

Figure 5 is a top plan view of the acceptor;

Figure 6 is a horizontal sectional view of the acceptor taken along the line X-X' in Figure 1, with the right side cover shown detached from the body and the left side cover omitted;

Figure 7 is a vertical sectional view of the acceptor taken along the line Y-Y' in Figure 1, with the right side cover shown detached from the body and the left side cover omitted;

Figure 8 is a vertical sectional view of the acceptor taken along the line Z-Z' in Figure 1, with the right side cover shown detached from the body and the left side cover omitted;

Figure 9 illustrates the horizontal curvature of the coin guiding surface through the coin sensing station;

Figure 10 illustrates the vertical curvature of the coin guiding surface through the coin sensing station;

Figure 11 is a top plan view of the acceptor when a coin enters its coin inlet;

Figure 12 is a schematic illustration of the passage of the coin through the coin sensing station;

Figure 13 is a plan view of one of the sensor coils S1, S2;

Figure 14 is a sectional view of the coil shown in Figure 13;

Figure 15 is a top plan view of the sensor coil S3;

Figure 16 is a side view of the coil shown in Figure 15;

Figure 17 is a plan view of a mounting for the sensor coils;

Figure 18 is a schematic illustration of the interaction between the coin and the sensor coils;

Figure 19 is an illustration of the waveforms produced by the interaction of Figure 18; and

Figure 20 is a schematic sectional view corresponding to Figure 10, of a modified coin guiding surface

Overview of coin acceptor

Figure 1 illustrates the general configuration of a multi-denomination acceptor according to the invention. The acceptor includes a main body 1 with a coin run-down path 2 along which coins under test pass edgewise from an inlet 3 through a coin sensing station 4 and then fall towards a gate 5 which has first and second gate arms 5a, 5b that open and close a coin accept path 6 and a coin reject path 7. A test is performed on each coin as it passes through the sensing station 4. If the outcome of the test indicates the presence of a true coin, the gate arm 5a is opened and arm 5b is closed so that the coin can pass to the accept path 6, but otherwise, the gate arm 5a remains closed and the gate arm 5b closed so that the coin is deflected to the reject path 7. The coin path through the acceptor for a coin 8 is shown schematically by dotted line 9.

The coin sensing station 4 includes three coin sensing coil units S1, S2 and S3, which are energised in order to produce an inductive coupling with the coin. Also, a coil unit PS is provided in the accept path 6, downstream of the gate 5, to act as a credit sensor in order to detect whether a coin that was determined to be acceptable, has in fact passed into the accept path 6. The credit sensor may be mounted in a cash box (not shown) that receives true coins from the accept path rather than the acceptor itself.

The coils are energised at different frequencies by a drive and interface circuit 10 shown schematically in Figure 2. Eddy currents are induced in the coin under test by the coil units. The different inductive couplings between the four coils and the coin characterise the coin substantially uniquely. The drive and

interface circuit 10 produces corresponding digital coin parameter data signals x_1, x_2, x_3 as a function of the different inductive couplings between the coin and the coil units S1, S2, S3 and S4. A corresponding signal is produced for the coil unit PS. The coils S1 and S2 have a small diameter in relation to the diameter of coins under test in order to detect the inductive characteristics of individual chordal regions of the coin. Improved discrimination can be achieved by making the area A of the coil unit S which faces the coin, for the coil units S1 and S2, smaller than 72 mm^2, which permits the inductive characteristics of individual regions of the coin's face to be sensed. Coil unit S3 is wound on an elongate bobbin and extends along the coin path. The configuration of the coil units will be explained in more detail hereinafter.

In order to determine coin authenticity, the coin parameter signals produced by a coin under test are fed to a microcontroller 11 which is coupled to a memory 12. The microcontroller 11 processes the coin parameter signals x_1, - x_3 derived from the coin under test and compares the outcome with corresponding stored values held in the memory 12. The stored values are held in terms of windows having upper and lower value limits. Thus, if the processed data falls within the corresponding windows associated with a true coin of a particular denomination, the coin is indicated to be acceptable, but otherwise is rejected. If acceptable, a signal is provided on line 13 to a drive circuit 14 which operates the gate 5 shown in Figure 1 so as to allow the coin to pass to the accept path 6. Otherwise, the gate 5 is not opened and the coin passes to reject path 7.

The microcontroller 11 compares the processed data with a number of different sets of operating window data appropriate for coins of different denominations so that the coin acceptor can accept or reject more than one coin of a particular currency set. If the coin is accepted, its passage along the accept path 6 is detected by the post acceptance credit sensor coil unit PS, and the unit 10 passes corresponding data to the microcontroller 11, which in turn provides an output on line 15 that indicates the amount of monetary credit attributed to the accepted coin.

The sensor coil units S each include an inductor coil connected in an individual oscillatory circuit and the coil drive and interface circuit 10 includes a multiplexer to scan outputs from the coil units sequentially, so as to provide data to the microcontroller 11. Each circuit typically oscillates at a frequency in a range of 50-150 kHz and the circuit components are selected so that each sensor coil S1-S4 has a different natural resonant frequency in order to avoid cross-coupling between them.

As the coin passes each of the sensor coil unit S1-S3, its impedance is altered by the presence of the coin over a period of ~100 milliseconds. As a result, the amplitude of the oscillations through the coil is modified over the period that the coin passes and also the oscillation frequency is altered. The variation in amplitude and frequency resulting from the modulation produced by the coin is used to produce the coin parameter signals x_1, - x_3 representative of characteristics of the coin.

The coin rundown path

Figure 3 is a schematic, perspective, exploded view of the coin acceptor, showing the main body 1 together with left and right covers 16, 17. The path 9 for coins is defined between the main body 1 and the right cover 16. The electronics shown in Figure 2 are mounted (out of view in Figure 3) on the main body and is covered by the left cover 17. Both of the covers 16, 17 are fixedly located on the main body 1 in use. There is no conventional door arrangement to allow the release of coin jams. The acceptor has a front side surface 18, rear side surface 19, top surface 20, and underside 21.

The coin rundown path 2 is defined by a curved surface 22 on the main body 1 and a curved coin guiding surface 23 on the right side cover 16. The coin guiding surface 23 extends into the coin inlet 3 as can be seen from the top plan view of Figure 5. The curvature of the coin guiding surface 23 decreases towards the front side surface 18 so as to guide incoming coins towards the front side.

wall 18 as they enter the acceptor through the coin inlet 3. This will be explained later.

Referring to Figures 3 and 4, the right side cover also includes an inclined, coin rundown edge 24 to guide coins along the rundown path 2.

As shown in the sectional view of Figures 6 – 8, the coin guiding surface 22 is curved both when viewed in horizontal and vertical section and extends from the coin inlet 3 to a generally vertical planar surface region 25 on the main body 1, illustrated in Figure 3.

As shown in Figures 9 and 10, the surface 22 has a radius of curvature R_h in a horizontal direction and also a curvature R_v in horizontal section. Thus, as the coin moves across the surface 22 as it travels along the path 9, it moves both in a horizontal and vertical curve.

Figures 11 and 12 illustrate the passage of a coin 26 through the coin sensing station 24. As shown in Figure 11, when coin 26 is inserted into the coin inlet 3, the curved surface 23 on the right side cover 16, guides the coin onto the curved surface 22 on the main body 1 and also directs it towards the front side wall 18 into the position shown in Figure 12. The coin thus travels in the direction of arrow A from the inlet 3 to the position shown in Figure 12.

Thereafter, the coin 26 moves in a curved path shown by arrow B through the coin sensing station. The coin falls by gravity down the inclined ledge 24 and the generally vertically and horizontally curved nature of the surface 22 ensures that one of the major circular side faces of the coin 26 is slidably engaged with surface 22 and is urged by a centrifugal force against the surface 22 as it moves along path B through the sensing station 4. Thus, tendency for the coin to wobble is materially reduced due to the fact that it is held by centrifugal force in sliding engagement with the surface 22. In contrast, conventional validators have used a linear path so that even if the coin were inclined to the vertical, the

rotating coin would tend to try and stand upright as a result of its rotation thereby inducing coin wobble.

When the coin reaches the end of path B, it then falls due to gravity along path C over the generally vertical surface 25 to be accepted or rejected on accept path 6 or reject path 7 in the manner previously described, under the control of gate 5.

Since the coin 26 is urged against surface 22 by centrifugal force, spacing between the side walls of the coin rundown path can be made larger than in conventional coin acceptors, obviating the requirement for a hinged door to release coin jams. Thus, the right side cover 16 can be fixedly attached to the main body 1 without the need for a hinged coin door to clear coin jams.

The configuration of the sensor coils S1, S2 and S3 will now be described in more detail. Figures 13 and 14 illustrate the construction of the sensor coils S1 and S2. Each of the coils comprises a generally cylindrical bobbin 27 of plastics material, on which windings of a coil 28 are formed. Bobbin 27 is push fitted into a so-called half pot core 29 made of sintered ferrite material. The ends of the winding 28 are mounted in plastics terminal pieces 30 that extend through slots 31 in the cylindrical side wall of the half pot core 29.

Figures 15 and 16 are plan and side views respectively of the sensor coil S3. The coil comprises an elongate bobbin 32 made of ferrite material on which copper windings 33 are formed. The bobbin is mounted on a rectangular mounting bracket 34 that has a locating lug 35. The coils S1, S2 and S3 are push fitted into a mounting bracket 36 is provided with recesses 37, 38 and 39 to receive the coils S1, S2 and S3 respectively, with the recess 39 including a region 39a to receive the locating lug 35 on coil S3. The mounting bracket 36 is held by screws fitted through mounting holes 40, 41 on the rear of the inclined surface 22 as illustrated in Figure 6.

Figures 18 and 19 illustrate the response produced by the sensor coils S1, S2 and S3 as coin 26 on the curved surface 22. In Figure 18, the coin 26 is shown moving from position 26-1 to 26-2. As the coin 26 moves past coil S2, it forms a inductive coupling with the coil and a corresponding coin parameter signal x_1 produced by the coil S1 is shown in Figure 19 as a function of time. The amplitude deviation of the signal x_1 is a function primarily of the material of which the coin is made and the coil senses the material content of the coin along the cordal region of the coin. A similar output is produced by coil S2. Since coil S2 is energised in a different frequency from coil S1, the amplitude deviation is different but similarly dependent on the material from which the coin is made.

The elongate coil S3 provides an indication of the diameter of the coin. As the coin passes the coil, a generally rectangular amplitude deviation x_3 is produced as shown in Figure 19 and it will be understood that the width d of the pulse, from time t1 to t2, is dependent on coin diameter. It has been found in accordance with the invention that the elongate coil S3 provides a highly reliable indication of coin diameter.

An advantage of the arrangement of coils S1-S3 is that they are all mounted on the same side of the coin rundown path, on the rear wall of the main body that provides the curved surface 22. Thus, the inductive coupling with a coin under test can reliably be formed with the coils through the curved surface 22, and the coin is urged against it by centrifugal force, as previously explained. Therefore the distance between the coin under test and the coils S1-S3 remains substantially constant from coin to coin, which improves reliability of the coin parameter signals produced by the coils.

Also, providing the coils S1-S3 only one side of the path 2 has the advantage that no electrical connections need to be made between the main body 1 and the right cover 16, which reduces the cost of the coin acceptor.

Referring now to Figure 20, a modification of the acceptor is shown, in which the curved surface 22 includes negative pressure relief holes 43. It has been found that as the coin 26 slides over the surface 22, the intimate contact between the coins and the surface can give rise to a negative pressure region being developed between the surface of a coin that contacts the curved surface 22, which can impede progress of the coin along the path. In accordance with the invention, the negative pressure relief holes 43 cause any negative pressure to be released and thereby free up the progress of the coin along the rundown path.

Many modifications and variations fall within the scope of the invention. For example, whilst the acceptor has been described for use with coins, it can also be used with tokens and other similar items with an attributable monetary value.

Claims

1. A coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, the path including a coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the sensing station, wherein the path is curved such that the said face of the coin is urged by centrifugal force against the coin guiding surface as it moves along the path.

2. A coin acceptor according to claim 1 wherein the coin is urged by centrifugal force against the coin guiding surface as it moves through the sensing station.

3. A coin acceptor according to any preceding claim comprising a body including the coin guiding surface, and a cover mounted on the body, wherein the coin path extends between said surface and the cover.

4. A coin acceptor according to claim 3 wherein the cover is fixedly mounted on the body, without a coin jam release mechanism.

5. A coin acceptor according to any preceding claim including a coin inlet opening and a curved inlet surface for guiding a coin inserted in the inlet to a particular region of the coin guiding surface.

6. A coin acceptor according to any preceding claim including wherein the coin guiding surface is configured to relieve a pressure differential between the major face of the coin and the coin guiding surface.

7. A coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, and sensor coils at the coin sensing station, one of said coils comprising an elongate winding extending longitudinally along the coin rundown path.

8. A coin acceptor according to claim 7 wherein the elongate coil is wound on an elongate former which is longer than it is wide.

9. A coin acceptor according to claim 8 wherein the elongate coil is longer than the maximum diameter of coins to be accepted thereby.

10. A coin acceptor according to claim 7, 8 or 9 including at least one coil of circular cross section at the sensing station.

11. A coin acceptor according to claim 10 wherein the circular coil has a diameter smaller than the minimum diameter of coins to be accepted thereby.

12. A coin acceptor according to any one of claims 7 to 11 including processing circuitry coupled to the elongate coil to derive therefrom a coin parameter signal as a function of coin diameter.

13. A coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, the path including a curved coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the sensing station, and a side wall opposite to the coin guiding surface, said coin rundown path extending between the coin guiding surface and the sidewall, wherein said side wall is fixedly mounted relative to the curved coin guiding surface.

14. A coin acceptor comprising a coin sensing station, a coin rundown path extending through the sensing station, the path including a curved coin guiding surface on which a major face of the coin lies in sliding engagement during its passage along the path through the sensing station, and means to relieve a pressure differential between the major face of the coin and the coin guiding surface to inhibit coins sticking to the coin guiding surface.

15. A coin acceptor according to claim 14 including pressure relief holes through the coin guiding surface.

16. A coin acceptor substantially as hereinbefore e described with reference to the accompanying drawings.

Abstract

Improved Acceptor

A coin acceptor includes a coin sensing station with two generally circular coils (S1, S2) and an elongate coil (S3) mounted on one side of a coin guiding surface that is curved so that a coin (26) under test is thrown by centrifugal force into sliding engagement with the surface (22) to form an inductive coupling with the coils to test coin acceptability.

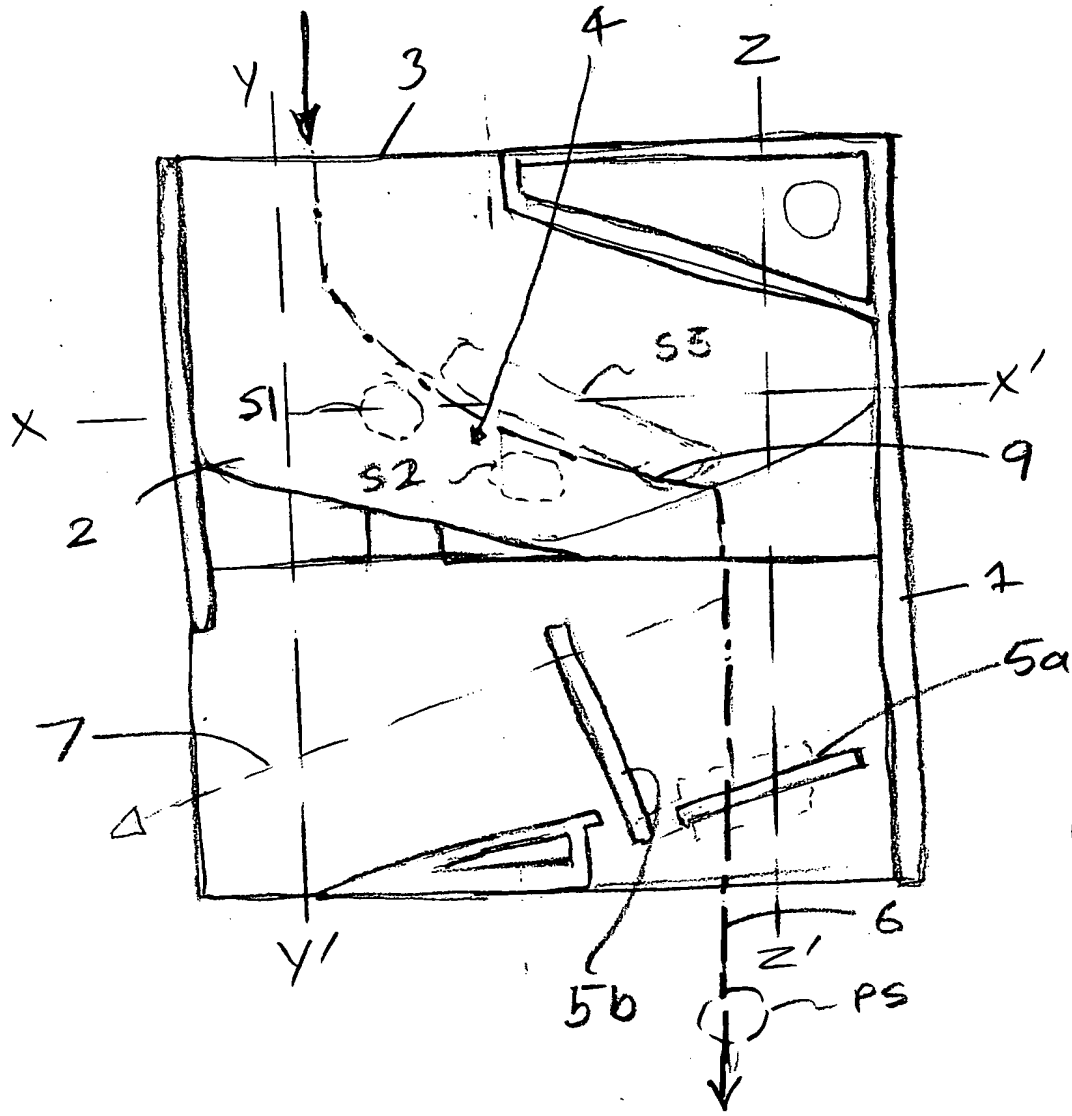
Y
3
4
Z
S3
X
S1
X'
9
S2
2
1
5a
7
4
6
Y'
Z'
5b
PS

FIG. 1

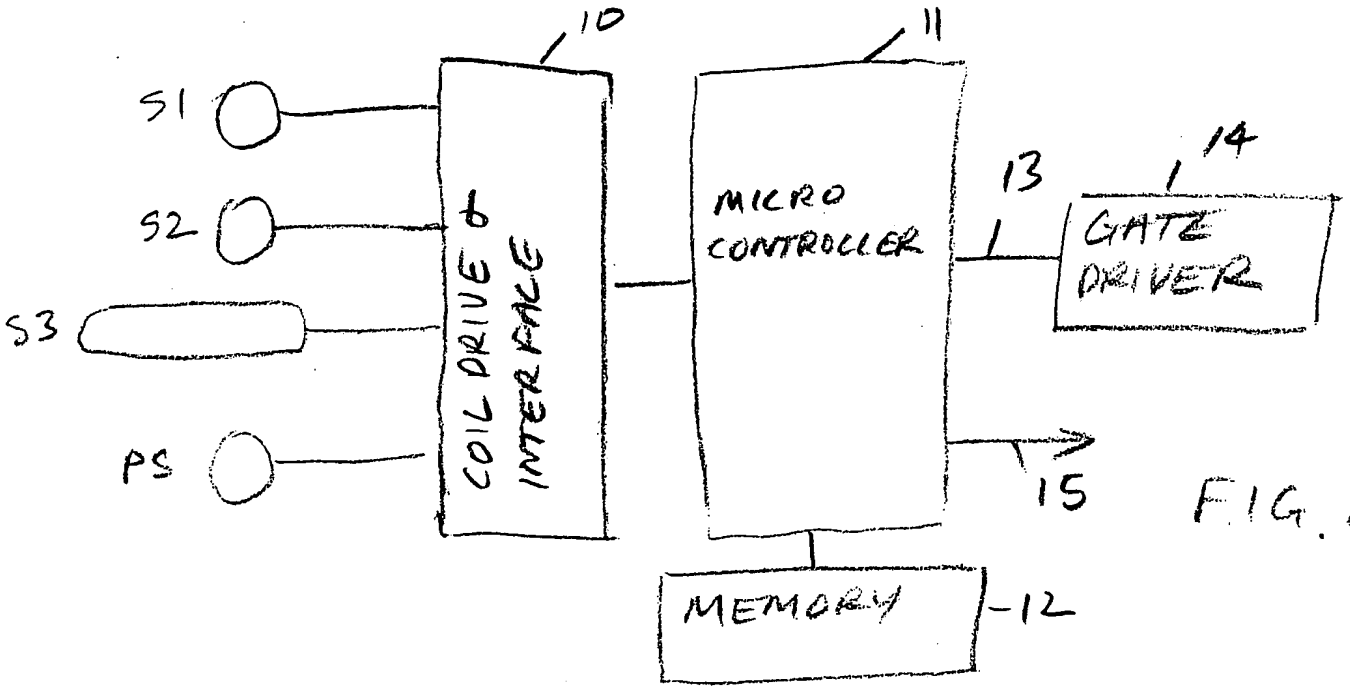
10
11
S1
S2
S3
PS
COIL DRIVE & INTERFACE
MICRO CONTROLLER
13
14
GATE DRIVER
15
MEMORY
12

FIG. 2

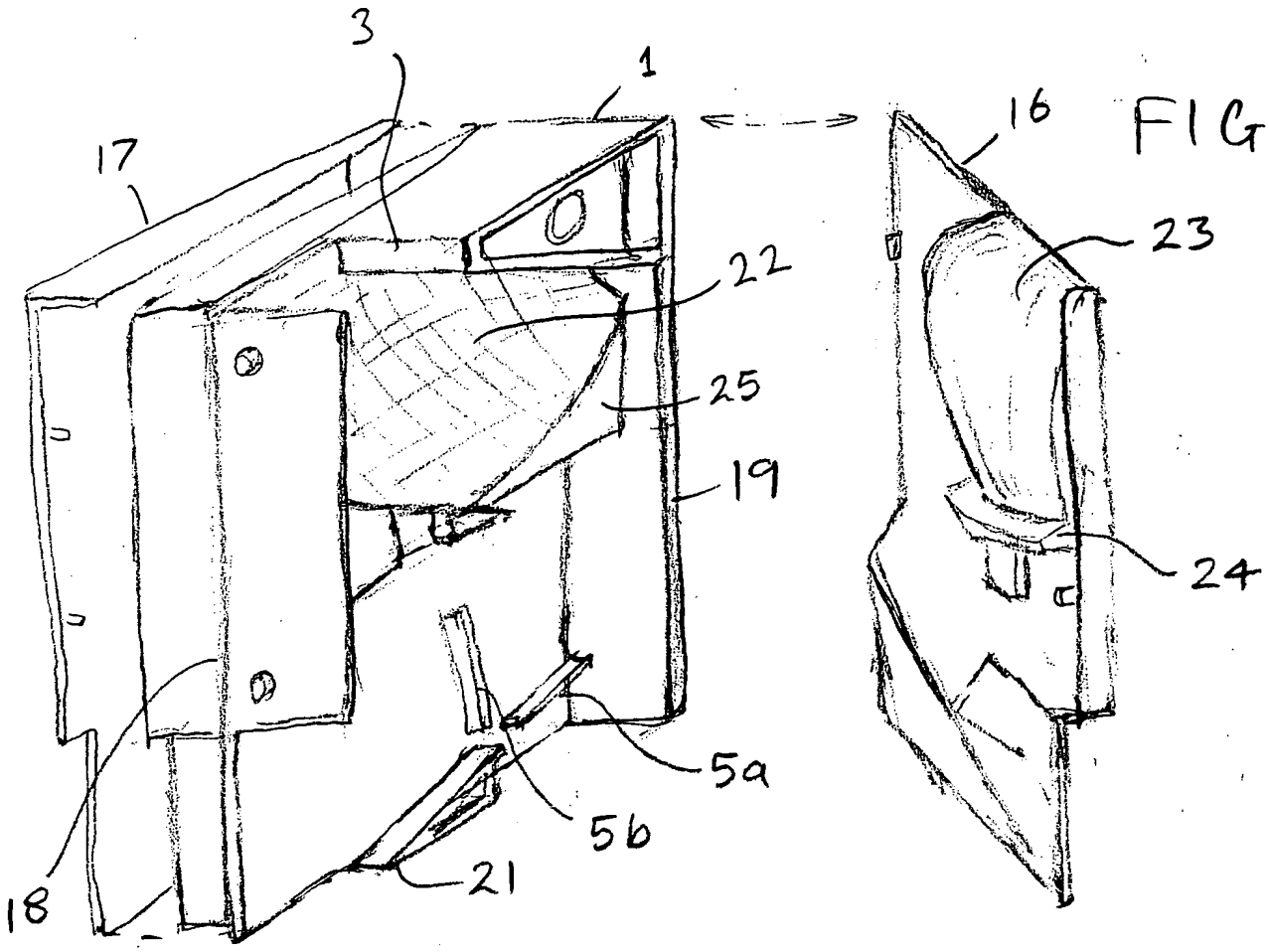

FIG. 3

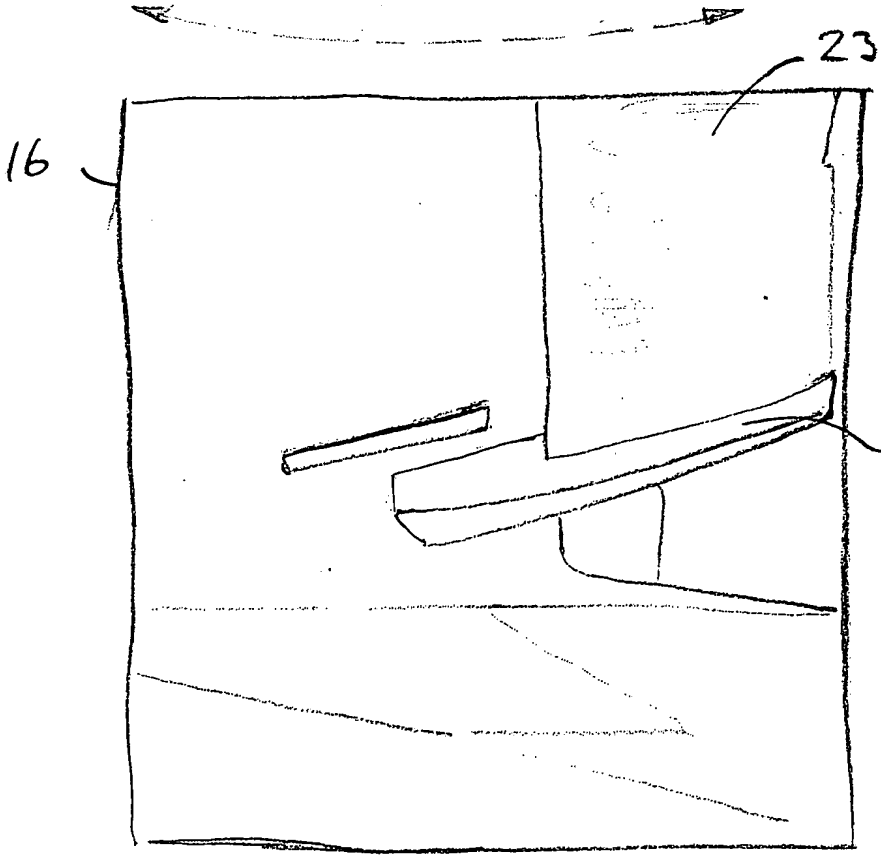

FIG. 4

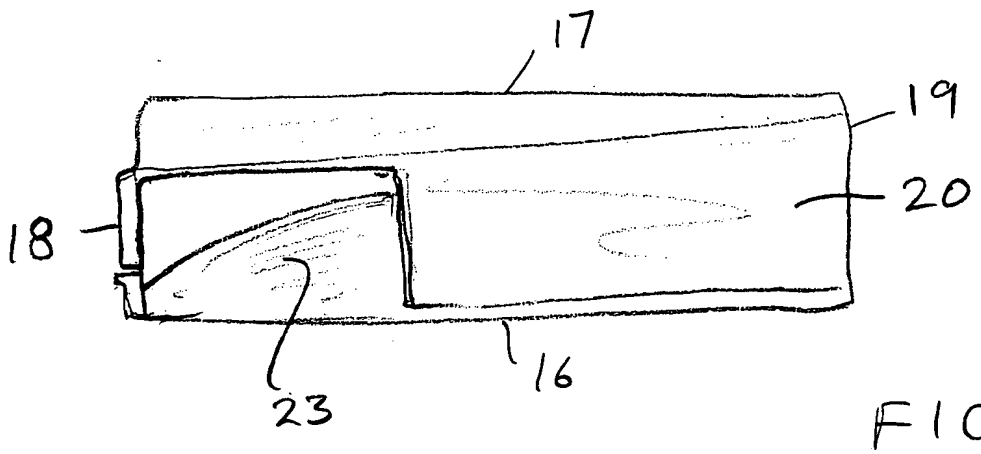

FIG. 5

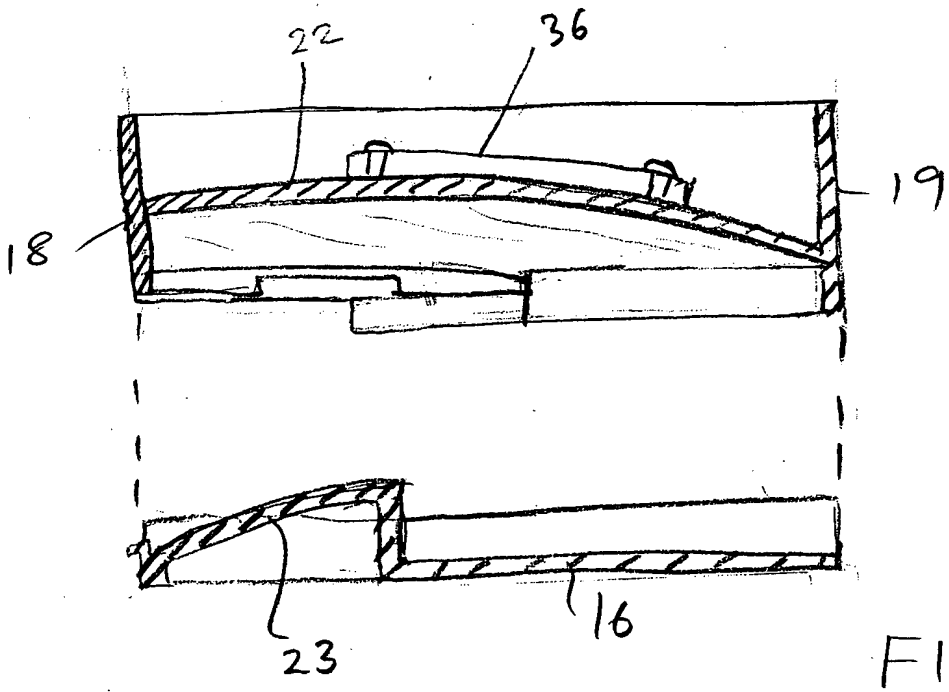

FIG. 6

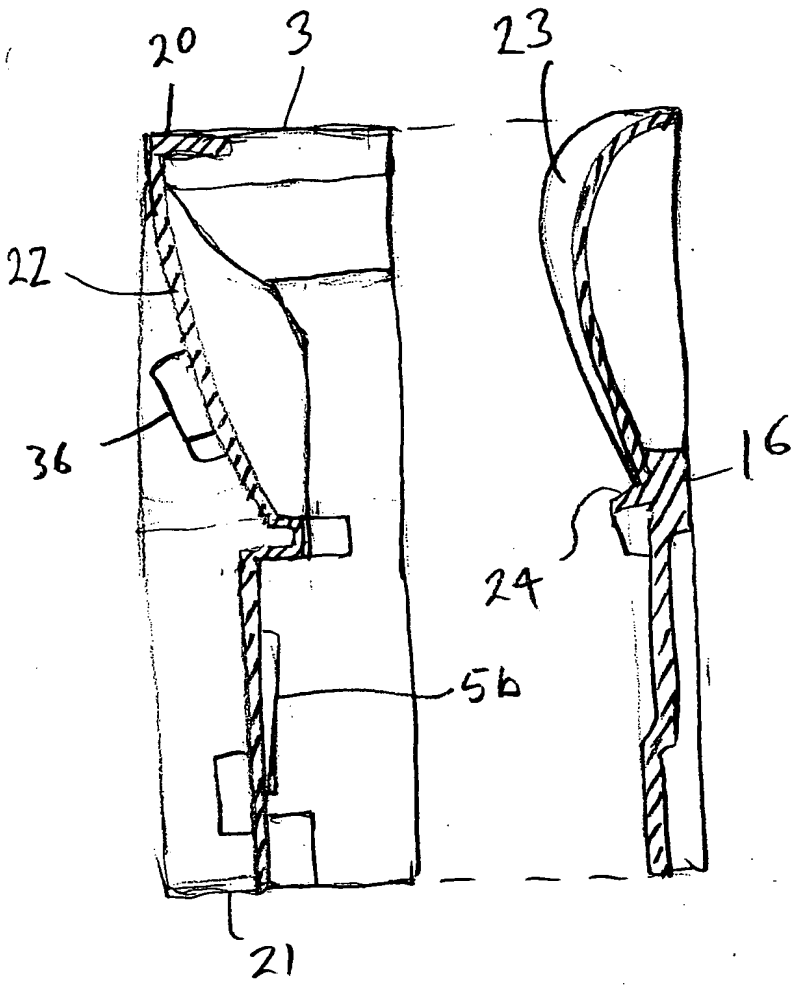

FIG. 7

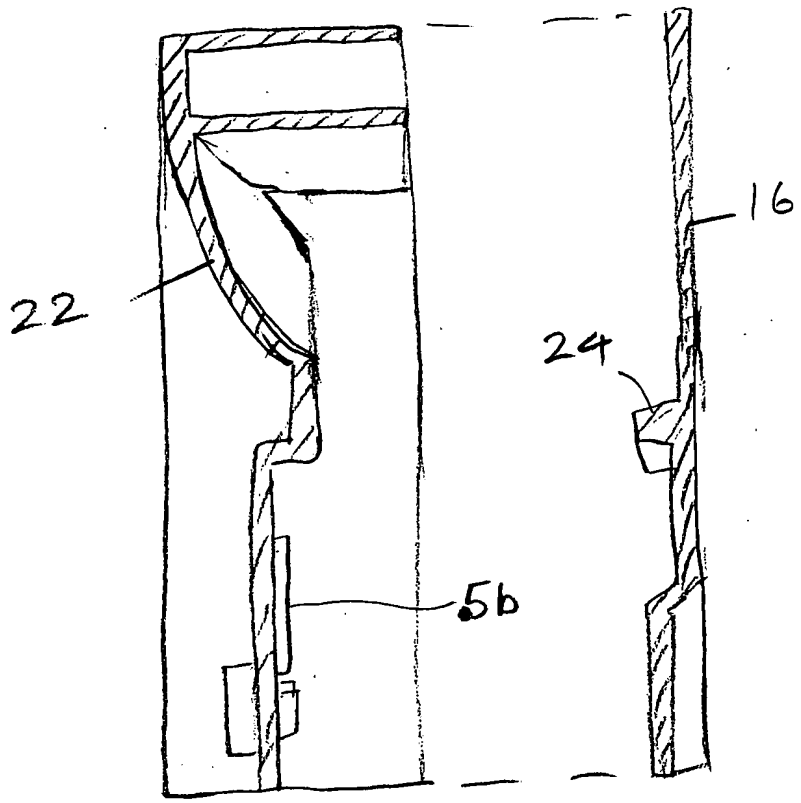

FIG. 8

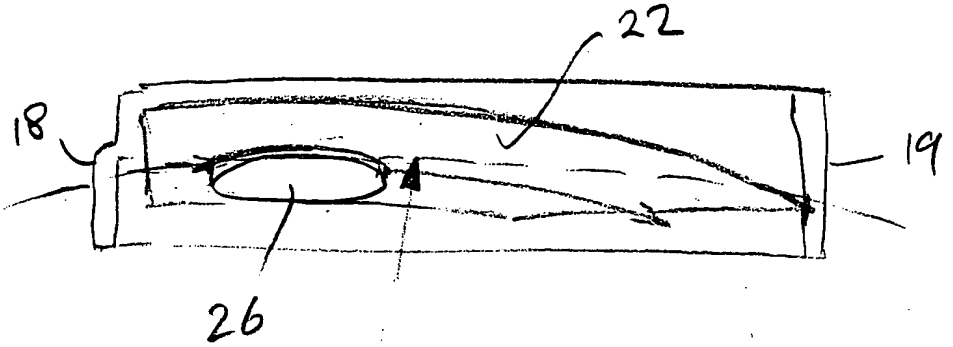

FIG. 9

R_h

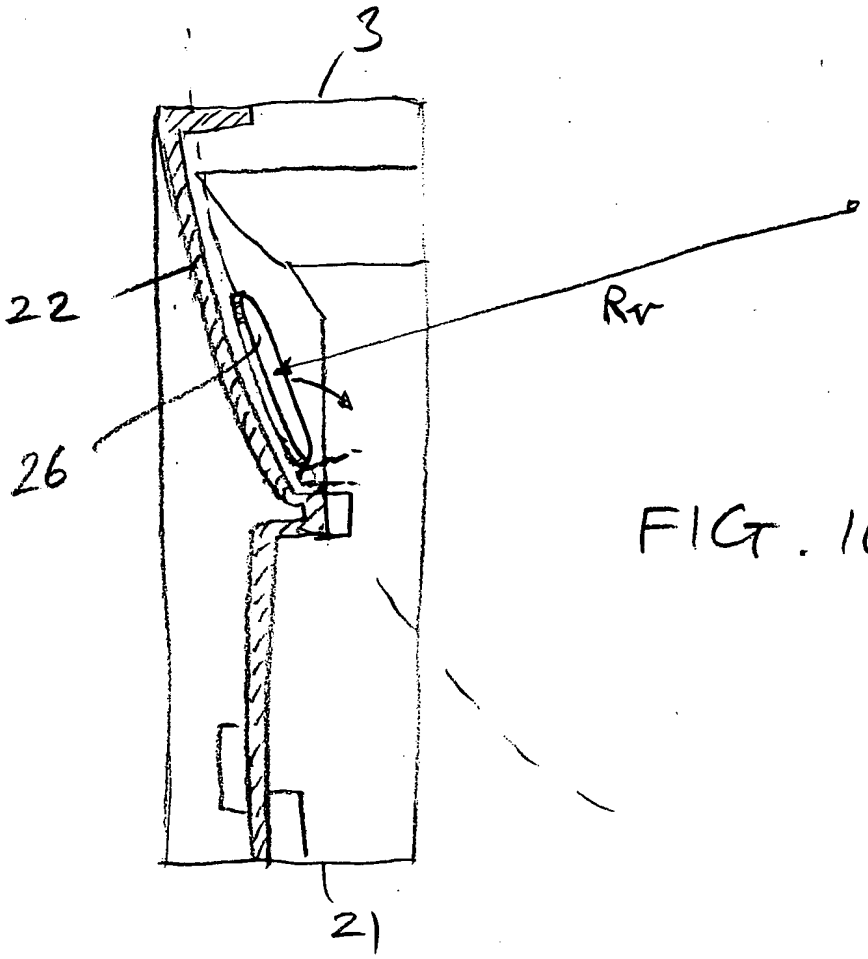

FIG. 10

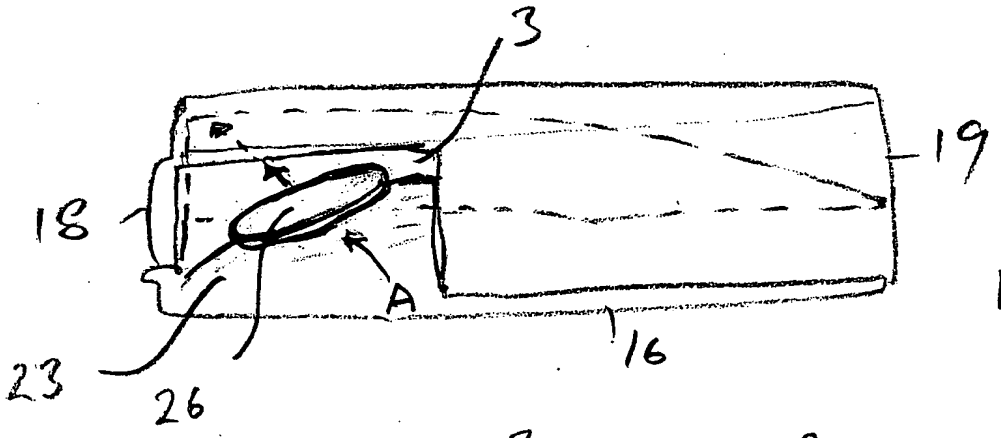

FIG. 11

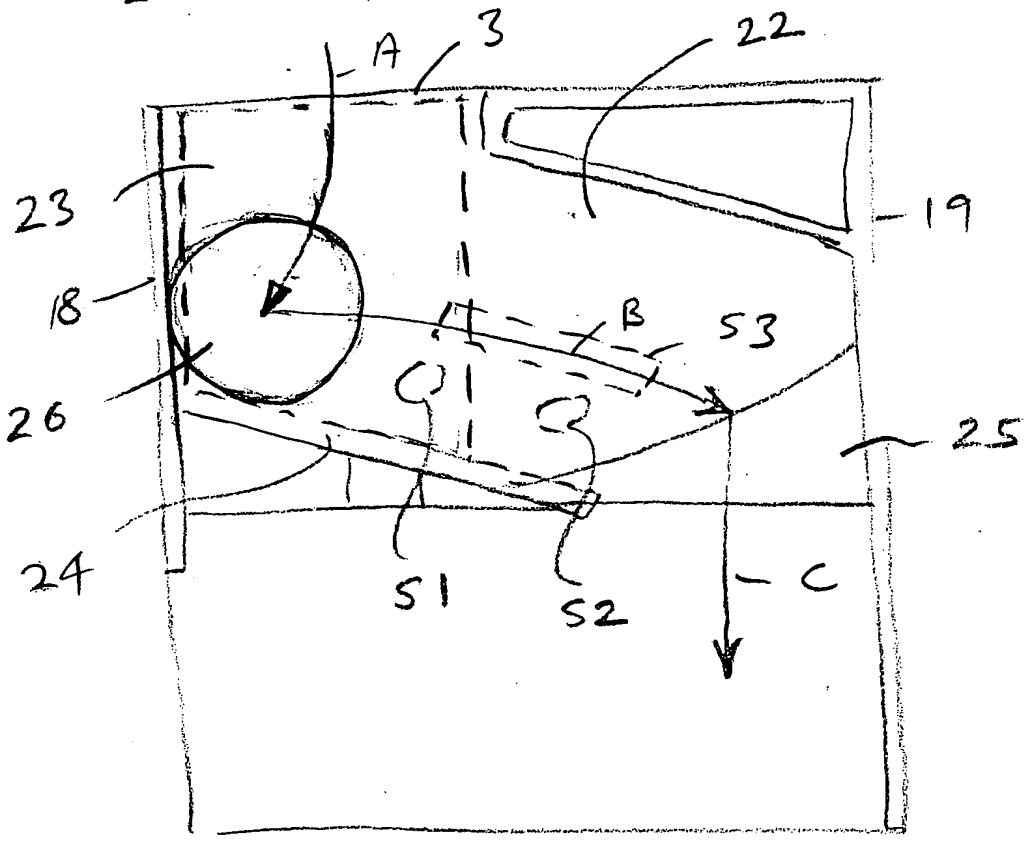

FIG. 12

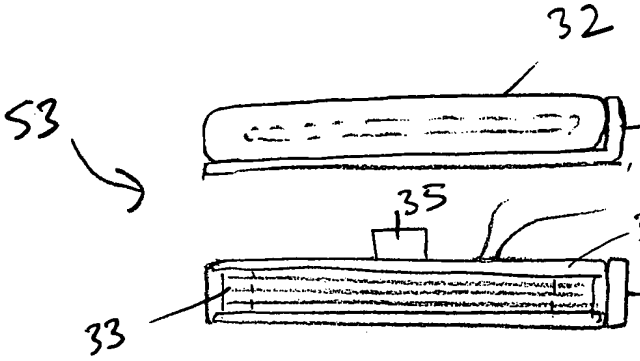

FIG. 16

FIG. 15

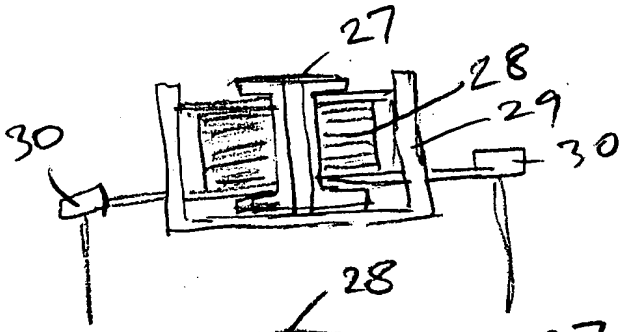

FIG. 14

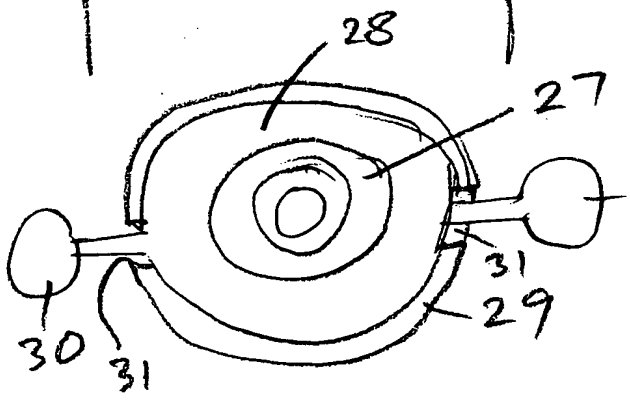

FIG 13

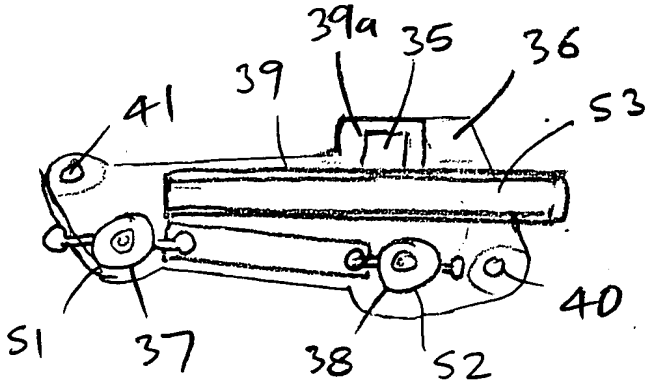

FIG. 17

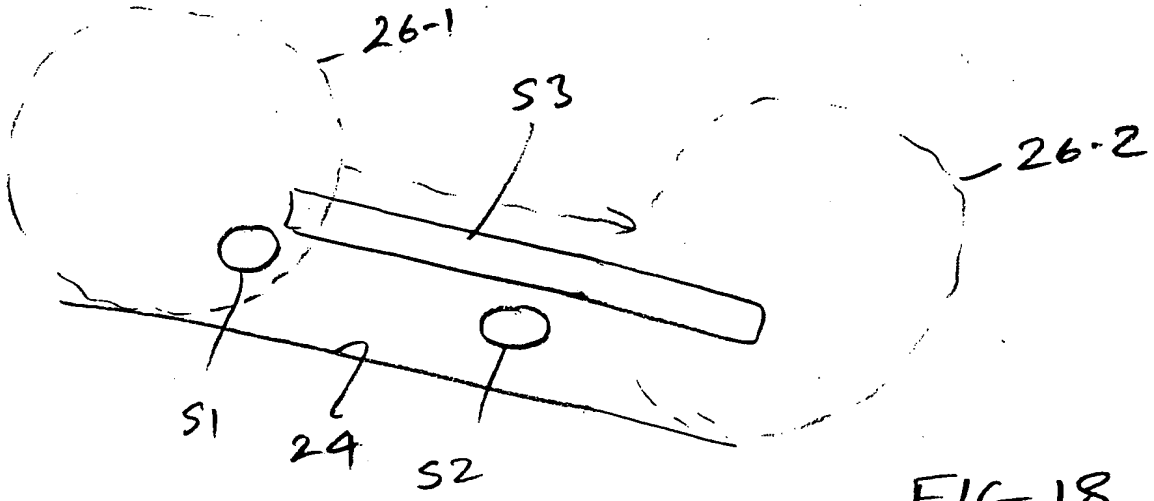

FIG 18

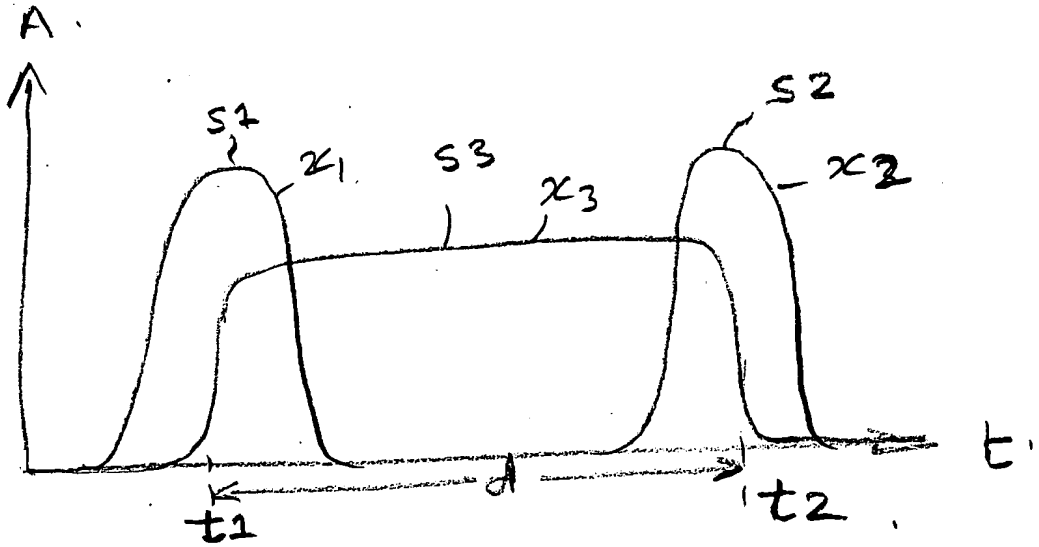

FIG. 19

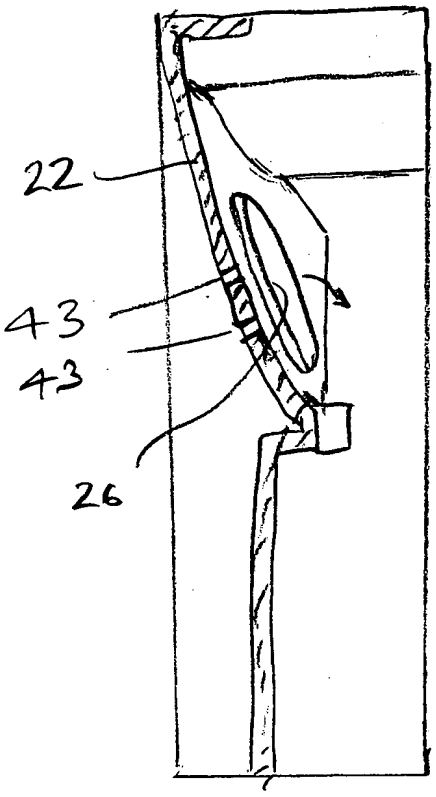

FIG. 20